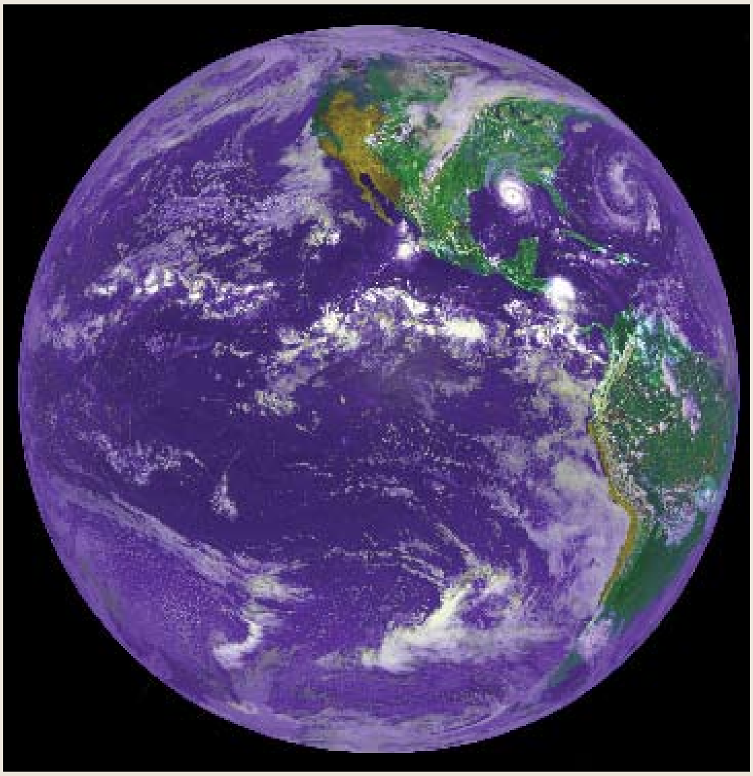
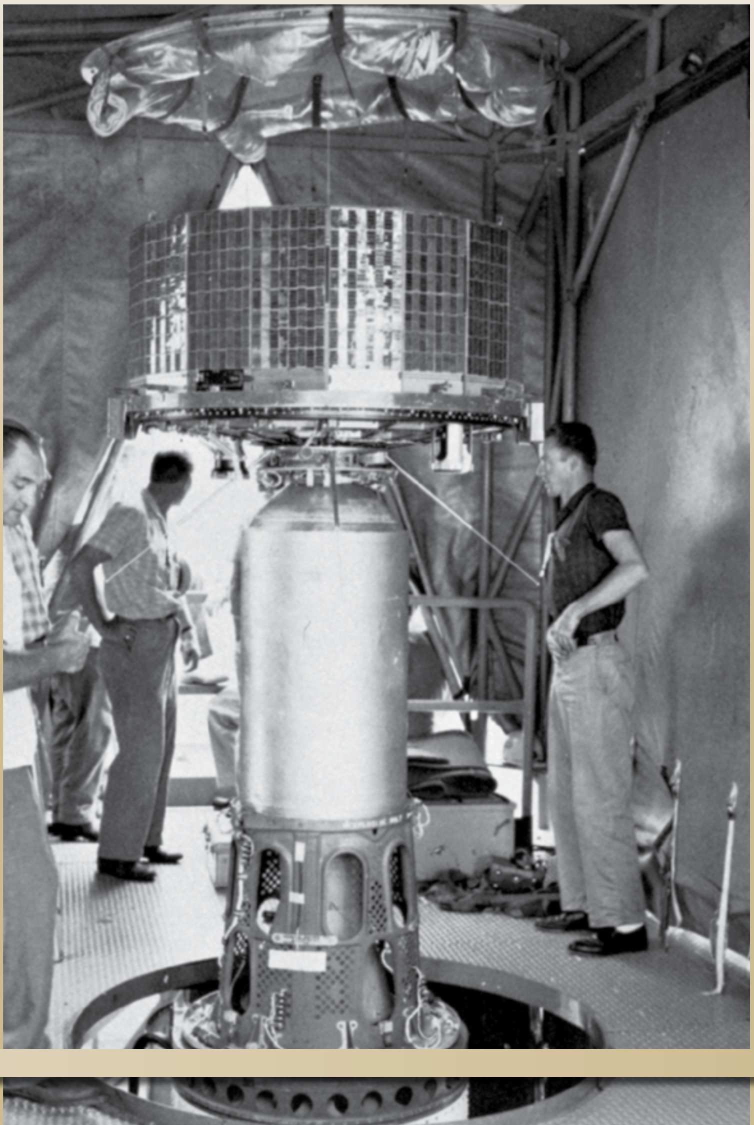
WEATHER EYES IN SPACE: NOAA SATELLITES

BY BARBARA STAHURA





In April 1960, the world's first weather satellite, TIROS I, zoomed into space at the tip of a rocket. Although not much more than a camera that could take photos in black and white during daylight, TIROS I — an acronym for Television Infrared Observation Satellite — revolutionized weather forecasting. In a sense, it freed meteorologists to view our planet from 450 miles high, complete with cloud formation patterns. Meteorologists used this eye in space to examine these patterns, which reveal emerging weather, and improve their forecasting abilities. TIROS I operated for 77 days, sending back 19,389 usable photos. TIROS II was launched in November 1960.

For the next half-century, NOAA, in partnership with NASA, has launched many more weather satellites. Technology has now grown more sophisticated and is able to provide increasingly detailed information on atmospheric conditions. This allows for accurate weather prediction days in advance, as well as long-term climate monitoring. Today, NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) operates the nation's environmental satellites. Two types of satellites — GOES and POES — provide global weather monitoring, producing billions of bits of data and photos daily.

GOES — Geostationary Operational Environmental Satellites — orbit at 22,300 miles above the equator at the same speed as Earth's rotation, which means they provide a full-disc view of Earth as they hover always at the same point. Ever-vigilant, the two GOES presently in orbit provide constant views of the United States that allow meteorologists to spot the atmospheric triggers for severe weather such as hurricanes, tornadoes, Nor'easters, hail storms, and flash floods; and then to track storm development and movement. GOES satellites are the backbone of short-term weather forecasting called "now-casting." NOAA combines the GOES' real-time data with that from Doppler radars and automated surface observing systems to provide severe-weather warnings and monitoring.

Top: An image taken on Aug. 25, 1992, by NOAA GOES-7 weather satellite of the Americas and Hurricane Andrew as it makes landfall on the Louisiana coast. *Credit: NOAA image by F. Hasler, M. Jentoft-Nilsen, H. Pierce, K. Palaniappan and M. Manyin* **Right: An early TIROS satellite is mounted on the nose of a rocket prior to launch. TIROS satellites were 18-sided polygons, 22 1/2 inches high with a 42-inch diameter. They weighed between 270 and 300 pounds.** *Credit: NOAA Central Library Photo Collection*

TIROS-N three-dimensional cloud-top image of Hurricane Diana as it was strengthening from a Category III storm to a Category IV storm in September 1984. This was one of the earliest three-dimensional images of a hurricane from data obtained via satellite. *Credit: NOAA Central Library Photo Collection*

An image of Hurricane Katrina taken by a GOES satellite. *Credit: NOAA Environmental Visualization Program image*

POES — Polar-Orbiting Environmental Satellites — monitor the entire Earth from 500 miles up, making complete north-to-south orbits in about 100 minutes for about 14.1 orbits daily. In addition to data for long-term weather forecasting, their technology — light-years beyond that of TIROS — provides visible and infrared radiometer data for imaging purposes, radiation measurements, temperature, and moisture profiles. POES satellites collect global data for a broad range of environmental-monitoring applications, including climate research, ocean dynamics research, volcanic eruptions, forest fire monitoring, global vegetation analysis, and even search and rescue.

Satellite Information Saves Lives and Property

NOAA weather satellites were essential in saving lives and reducing economic losses from recent severe-weather events. In 1992, NOAA forecasts, resulting from satellite data preceding Hurricane Andrew, allowed the evacuation of thousands of people in Florida and Louisiana. Only 26 people died — far fewer than previous hurricanes of similar strength. NOAA satellite data would prove crucial again in 2005 with Hurricane Katrina. NOAA's hurricane forecasters used the satellite data and imagery to provide watches and warnings with lead times of 44 and 32 hours, respectively — an additional eight hours beyond when alerts are typically issued. In another example of the impact of NOAA satellites, information from POES monitors increasing sea-surface temperatures. This data supported NOAA's prediction of the El Niño of 1997-98 six months in advance. This allowed communities sufficient time to reduce the impact of this climatic phenomenon. (See "Forecasting El Niño and La Niña" on page 59.)

Not as well known is the use of NOAA satellites in the international Search and Rescue Satellite-Aided Tracking System, called COSPAS-SARSAT. This system uses a constellation of satellites from many nations to detect and locate distress signals from emergency beacons onboard aircraft and boats and from handheld personal locator beacons.

Finally, NOAA operates satellites for the Department of Defense through the Defense Meteorological Satellite Program (DMSP). Since the 1960s, DMSP has assisted the U.S. military in planning and conducting operations worldwide.

New GOES and POES Planned

As advanced as GOES and POES already are, NOAA is planning for more sophisticated instruments to improve its weather-forecasting abilities and environmental monitoring in response to climate change.

GOES-R, scheduled for launch in 2014, will scan the Earth five times faster and deliver photos 40 times faster than the satellites now in orbit. It will improve hurricane monitoring with sensors able to analyze the various parts of these monster storms. Even more amazing, GOES-R will continuously detect lightning from space — an essential tool in predicting hurricanes.

NPOESS, or the National Polar-orbiting Operations Environmental Satellite System, is NOAA's next generation of polar satellites. Managed by the Integrated Program Office, NOAA, the Department of Defense, and NASA, NPOESS will gather information about Earth's weather, oceans, land, and atmosphere, and distribute it to civilian, military, and scientific communities.

NOAA Satellites — www.noaa.gov/satellites.html
National Environmental Satellite, Data, and Information Service (NESDIS) — www.nesdis.noaa.gov

Sgt. David J. Owen, a Defense Meteorological Satellite Program (DMSP) operations maintenance technician with the 2130th Communications Group, U.S. Air Force Communications Command (AFCC), completes an inspection of a DMSP receiver. NOAA also operates such satellites in conjunction with the Department of Defense. *Credit: Department of Defense photo*

SPACE HAS WEATHER, TOO

Weather does not exist only on the Earth; space has weather, too. Instead of high pressure systems or cold fronts, space weather is a consequence of the sun's behavior. Changes in the solar wind interact with the Earth's magnetic field. Instead of rain and wind, space weather produces solar radiation storms, radio blackouts, and geomagnetic storms. These storms can interfere with radio communication, cause electrical blackouts, and create concerns about radiation for people in high-flying aircraft. So, the more we depend on technology, the more we need to understand space weather.

The Space Environment Center (SEC) is jointly operated by NOAA and the U.S. Air Force. It is one of NOAA's nine National Centers for Environmental Prediction and is the first defense against the effects of solar weather as well as the nation's official source of space weather alerts and warnings.

Space weather storms have huge economic impacts. For instance, airline flights at high latitudes are rerouted to avoid increased radiation and communication problems. If not accurately predicted, solar particles can damage the International Space Station's $1 billion arm, satellites, and the GPS system. A geomagnetic storm affecting electric power could result in a $3 billion to $6 billion loss in the gross domestic product.

SEC forecasters are responsible for predicting these storms from hours to weeks in advance. By alerting customers to impending solar storms, the SEC enables them to take protective actions that reduce the threat to lives, property, and the economy.

Space Environment Center – www.sec.noaa.gov